

# Reexamination of the N=90 Transitional Nuclei $^{150}\text{Nd}$ and $^{152}\text{Sm}$

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The N=90 nuclei,  $^{150}\text{Nd}$  and  $^{152}\text{Sm}$ , are often called transitional nuclei. Lighter isotopes display vibration-like spectra, while heavier isotopes show more rotational-like behavior. Historically, excited states in these nuclei were described as rotational excitations of single-phonon states ( $\beta$  and  $\gamma$  vibrations) with deformations similar to that of the ground-state band (for example, see ref [1]). However, it has been claimed that certain properties of the bands, most notably the strength of the inter-band transitions, cannot be explained within this picture.

A newly suggested approach to describing the excited level structure of transitional nuclei is to apply the idea of a phase transition of the nuclear shape and to try to define a critical point of the shape change as a new benchmark against which nuclear properties can be compared [2,3]. In particular, the transition from a spherical harmonic vibrator to an axially deformed rotor has been described analytically [3] by introducing a dynamic symmetry, denoted as X(5), which arises when the potential in the Bohr Hamiltonian is decoupled into two components – an infinite square well potential for the quadrupole deformation parameter,  $\beta$ , and a harmonic potential well for the triaxiality deformation parameter,  $\gamma$ . Both  $^{150}\text{Nd}$  and  $^{152}\text{Sm}$  have been described in the literature as empirical realizations of the X(5) picture (that is, they lie very close to the idealized critical point of the shape transition) [4,5].

The issues raised in the interpretation of the excited level structure of these nuclei have spurred several new experimental studies that have yielded extensive new data, including accurate transition strengths [5,6,7]. We have shown [8] that the recent data, in particular the B(E2) values, can be well described by treating the

states in these nuclei as rotational bands and by including a  $\Delta K=0$  coupling between them. This would be the expected situation if the second  $0^+$  state in these nuclei is predominantly a  $\beta$  vibration. A microscopic justification of the parameters we extract (such as the contribution to the transition matrix elements attributable to the  $\Delta K=0$  coupling) is found in the pairing-plus-quadrupole model of Kumar [9]. Other descriptions, including the X(5) critical point picture, are considerably worse at reproducing the experimental data.

We conclude that while it is likely that the second  $0^+$  state in these nuclei is not a pure  $\beta$  vibration, describing the level sequence on this state as rotational and including an effective  $\Delta K=0$  coupling to the ground-state band, reproduces salient features rather well and provides the best presently available description of states in these transitional nuclei.

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